11/10/16 "Quality is not an act, it is a habit" -Aristotle

HW: Completing the Square worksheet (finish up to #10)

AIM: How do we solve quadratic equations by Completing the Square?

Warm Up: Factor the following:

1) x^2+2x+1 $(x+1)(x+1)=(x+1)^2$

2) x^2-4x+4 $(x-2)(x-2)=(x-2)^2$

3) x^2+6x+9 $(x+3)(x+3)$

4) $x^2-8x+16$ $(x-4)(x-4)$

These trinomials are all considered perfect square trinomials.

How can we solve a quadratic equation if we can not factor?

-We use a process called ***Completing the Square***

(*) roots, zeros, solutions all mean to find the variable

5) What are the roots of: $x^2 + 8x - 4 = 0$

recall : $ax^2 + bx + c = 0$

1) The "a" must be 1 (If it isnt, then divide the entire equation by the "a" value)	$x^2 + 8x - 4 = 0$ $+4 \quad +4$
2) Move the "c" (constant) term to the right side	$x^2 + 8x = 4$
3) Insert a space on each side in order to create a perfect square trinomial (remember to do it to both sides)	$x^2 + 8x + \square = 4 + \square$
4) Divide the "b" by 2 and then square the result. Add the result to both sides of the equation $x^2 + 8x + \square = 4 + \square$ half and square — and share	$x^2 + 8x + \boxed{16} = 4 + \boxed{16}$
5) Factor the trinomial on the left side	$(x+4)^2 = 20$
6) Take the square root of each side and solve (Remember that there are 2 solutions)	$x + 4 = \pm\sqrt{20}$ $x = -4 \pm \sqrt{20} = -4 \pm 2\sqrt{5}$ $x = -4 + 2\sqrt{5}$ $x = -4 - 2\sqrt{5}$

6) Find the roots of the function $y = 2x^2 - x - 1$.

Recall that the roots of a function are on the x-axis where y = 0

$\frac{0}{2} = \frac{2x^2}{2} - \frac{x}{2} - \frac{1}{2}$

$0 = x^2 - \frac{1}{2}x - \frac{1}{2}$

$x^2 - \frac{1}{2}x - \frac{1}{2} = 0$

$+\frac{1}{2} \quad +\frac{1}{2}$

$x^2 - \frac{1}{2}x = \frac{1}{2}$

$x^2 - \frac{1}{2}x + \frac{1}{16} = \frac{1}{2} + \frac{1}{16}$

Half $= \frac{-\frac{1}{2}}{2} = -\frac{1}{4}$ ←(*)

Square $= \left(-\frac{1}{4}\right)^2 = \frac{1}{16}$

Share $= \frac{1}{16}$

$\frac{9}{16}$

$x^2 - \frac{1}{2}x + \frac{1}{16} = \frac{9}{16}$

$\left(x - \frac{1}{4}\right)^2 = \frac{9}{16}$

$x - \frac{1}{4} = \pm\sqrt{\frac{9}{16}}$

$x - \frac{1}{4} = \pm\frac{3}{4}$

$+\frac{1}{4} \quad +\frac{1}{4}$

$x = \frac{1}{4} \pm \frac{3}{4}$

$\frac{1}{4} + \frac{3}{4} = 1$

$\frac{1}{4} - \frac{3}{4} = -\frac{2}{4} = -\frac{1}{2}$

7) Solve for x by completing the square:

$$x^2 + 2x = 4$$

$x^2 + 2x + \boxed{1} = 4 + \boxed{1}$

$\frac{2}{2} = 1$

$1^2 = 1$

$\pm\sqrt{(x+1)^2} = \pm\sqrt{5}$

$x + 1 = \pm\sqrt{5}$

$-1 \quad -1$

$x = -1 \pm \sqrt{5}$

HW Sheet

#1) $v^2 + 10v - 21 = 0$

$+21 \quad +21$

$v^2 + 10v + 25 = 21 + 25$

$\frac{10}{2} = 5$

$5^2 = 25$

$\sqrt{(v+5)^2} = \pm\sqrt{46}$

$v + 5 = \pm\sqrt{46}$

$v = -5 \pm \sqrt{46}$

2) $b^2 - 4b - 12 = 0$

$+12 \quad +12$

$b^2 - 4b + \underline{4} = 12 + \underline{4}$

$\frac{-4}{2} = -2$

$(-2)^2 = 4$

$(b-2)^2 = 16$

$b - 2 = \pm\sqrt{16}$

$b - 2 = \pm 4$

$+2 \quad +2$

$b = \pm 4 + 2$

$b = +4 + 2$ (6) and $b = -4 + 2$ (-2)

3) $v^2 - 14v - 44 = 0$

$+44 \quad +44$

$v^2 - 14v + \underline{49} = 44 + \underline{49}$

$\frac{-14}{2} = -7$

$(-7)^2 = 49$

$(v-7)^2 = 93$

$v - 7 = \pm\sqrt{93}$

$+7 \quad +7$

$v = 7 \pm \sqrt{93}$

11) $9n^2 = -77 + 18n$

$-18n \qquad -18n$

$9n^2 - 18n = -77$

$\frac{9n^2}{9} - \frac{18n}{9} = \frac{-77}{9}$

$n^2 - 2n + \boxed{1} = \frac{-77}{9} + \boxed{1}$

$\frac{-2}{2} = -1$ $\qquad \pm\sqrt{(n-1)^2} = \pm\sqrt{-\frac{68}{9}}$

$(-1)^2 = 1$

$n - 1 = \pm\sqrt{\frac{-68}{9}}$

$+1 \quad +1$

$n = 1 \pm \sqrt{\frac{-68}{9}}$

$n = 1 \pm i\sqrt{\frac{68}{9}}$

$n = 1 \pm i\frac{2\sqrt{17}}{3}$

$n = 1 \pm \frac{2i\sqrt{17}}{3}$

$\sqrt{\frac{68}{9}} = \frac{\sqrt{68}}{\sqrt{9}} = \frac{\sqrt{68}}{3}$

$\sqrt{68}$

$\sqrt{4}\ \sqrt{17}$

$2\sqrt{17}$

$\frac{\sqrt{68}}{\sqrt{9}} = \frac{2\sqrt{17}}{3}$

$$\sqrt{\frac{-68}{9}} = \frac{\sqrt{-68}}{\sqrt{9}} = \frac{\sqrt{-68}}{3}$$

$$\sqrt{-68}$$

$$\sqrt{-4} \quad \sqrt{17}$$

$$\frac{2i\sqrt{17}}{3}$$

12) $9v^2+5=18v$

$-18v \quad -18v$

$9v^2-18v+5=0$

$-5 \quad -5$

$\frac{9v^2}{9}-\frac{18v}{9}=\frac{-5}{9}$

$v^2-2v+\boxed{1}=-\frac{5}{9}+\boxed{1}$

$\frac{-2}{2}=-1$

$(-1)^2=1$

$\pm\sqrt{(v-1)^2}=\pm\sqrt{\frac{4}{9}}$

$v-1=\pm\sqrt{\frac{4}{9}}$

$v-1=\pm\frac{2}{3}$

$+1 \quad +1$

$v=1\pm\frac{2}{3}$

$v=1+\frac{2}{3}=\left(\frac{5}{3}\right)$ $v=1-\frac{2}{3}=\left(\frac{1}{3}\right)$

$v=\frac{1}{3},\frac{5}{3}$

15) $\frac{9m^2}{9} - \frac{20m}{9} - \frac{21}{9} = \frac{0}{9}$

$m^2 - \frac{20}{9}m - \frac{21}{9} = 0$

$+\frac{21}{9} \quad +\frac{21}{9}$

$m^2 - \frac{20}{9}m + \frac{100}{81} = \frac{21}{9} + \frac{100}{81}$

$\frac{-20}{9} \div 2 = -\frac{10}{9}$

$\left(\frac{-10}{9}\right)^2 = \frac{100}{81}$

$\sqrt{\left(m - \frac{10}{9}\right)^2} = \pm\sqrt{\frac{289}{81}}$

$m - \frac{10}{9} = \pm\frac{17}{9}$

$+\frac{10}{9} \quad +\frac{10}{9}$

$m = \frac{10}{9} \pm \frac{17}{9}$

$m = \frac{10}{9} + \frac{17}{9} = \frac{27}{9}$

$m = 3$

$m = \frac{10}{9} - \frac{17}{9} = -\frac{7}{9}$

$m = -\frac{7}{9}$

16) $\frac{10x^2}{10} - \frac{4x}{10} - \frac{32}{10} = \frac{0}{10}$

$x^2 - \frac{4}{10}x - \frac{32}{10} = 0$

$x^2 - \frac{2}{5}x - \frac{16}{5} = 0$

$\frac{-\frac{2}{5}}{2} = -\frac{1}{5}$

$\left(-\frac{1}{5}\right)^2 = \frac{1}{25}$

$x^2 - \frac{2}{5}x + \frac{1}{25} = \frac{16}{5} + \frac{1}{25}$

$\sqrt{\left(x - \frac{1}{5}\right)^2} = \pm\sqrt{\frac{81}{25}}$

$x - \frac{1}{5} = \pm\frac{9}{5}$

$+\frac{1}{5} \quad +\frac{1}{5}$

$x = \frac{1}{5} \pm \frac{9}{5}$

$x = \frac{1}{5} + \frac{9}{5} = 2$ $\quad x = \frac{1}{5} - \frac{9}{5} = -\frac{8}{5}$